



## MECH-402: Precision Pump Repair

### Abstract

In recent years, more and more companies have realized the need to emphasize a precision mentality and re-focus on the fundamental skills required to achieve “precision.”

As a part of Universal Technologies’ seminar progression, we generally begin with the “Maximizing Machinery Reliability...the skilled craftsman” seminar to focus on these basic, yet critical concepts. While without exception, this seminar has proven extremely successful for our clients, we keep hearing the question “**How can we take it to the next level?**”



While the scope of the “skilled craftsman” seminar is comprehensive, time limitations have prohibited more detailed discussions on specific subjects, such as precautions associated with certain types of couplings, proper use of additional precision measurement instruments, and detailed installation procedures for certain components such as specific bearing types. In researching how to address these issues, we realized that the next step is to enable the technician to effectively transfer the basic precision maintenance knowledge and skills while repairing specific types of equipment.

In this seminar, attendees gain additional knowledge and skills by applying the fundamentals or precision maintenance to tasks involving s of various types of **pumps**. The intensively hands-on curriculum includes activities during which attendees will follow step-by-step procedures while inspecting, evaluating, and assembling pumps.

Craft personnel will leave this seminar with *an applied understanding* of precision maintenance concepts:



Pump and gearbox repair activities include:

- ❑ Detailed pre-disassembly and disassembly inspections
- ❑ Machine Specific Precision Measurement and Component Inspection Procedures
- ❑ Rolling Element and Plane Bearing Installation Procedures
- ❑ Packing and Mechanical Seal Installation Procedures
- ❑ Precision Assembly Techniques
- ❑ Equipment Specific Installation Procedures



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## **Seminar Duration**

The recommended duration of this seminar is 40 hours depending on client preference, worker availability, and the attendees' backgrounds.

## **Who should attend?**

This seminar is designed primarily for maintenance, engineering, technical support and management personnel whose job functions involve rotating machinery repair. The scope of content is appropriate for technicians who have attended Universal Technologies' "Maximizing Machinery Reliability...the skilled craftsman" seminar, have a sound understanding of fundamental skills of precision maintenance, and are responsible for diagnosing problems and repairing and installing various types of pumps. This seminar is also beneficial for supervisors and others who provide support for such tasks.



## Associated Task(s)

1. When given the task of repairing a pump or gearbox, perform the task in a manner that demonstrates proficient knowledge and skills with the fundamentals of precision maintenance, including:
  - A. Performing required pre-disassembly and disassembly inspections
  - B. Proper interpretation of dimensions, tolerances, and fits
  - C. Proper use of precision measurement tools
  - D. Proper use of fasteners, torquing, and tensioning
  - E. Precision assembly techniques
  - F. Proper installation of bearings and seals
  - G. Precision installation of impellers and gears
  - H. Performing required post-assembly inspections
  - I. Proper equipment installation procedures

## Seminar Objectives

Upon successful completion of the seminar, the student will be able to:

1. Explain the benefits of precision maintenance and key components of a precision mentality.
2. For each of the following types of pumps, explain the basic principles of operation and functions of all major component parts:
  - A. Horizontal Split Case Centrifugal Pumps
  - B. Horizontal Overhung Centrifugal Pumps
  - C. Horizontal Back Pull Out Centrifugal Pumps
  - D. Vertical Centrifugal Single and Multi-stage Pumps
  - E. Positive Displacement Pumps
3. Explain and demonstrate how to properly perform pre-disassembly and disassembly inspections on each type of pump listed above.
4. Explain and demonstrate how to interpret and apply dimensions, tolerances and fit information provided by pump and gearbox manufacturers or approved procedures.
5. Properly use the following instruments to obtain required measurements on pumps, and gearboxes with an accuracy of +/- the instrument's smallest graduation:
  - A. Outside Micrometers
  - B. Inside Micrometers
  - C. Bore Micrometers
  - D. Depth Micrometers
  - E. Dial Indicators
  - F. Outside and Inside Calipers
  - G. Radius Gauges
6. Explain and demonstrate use of proper fastening, torquing and tensioning techniques during pump repair procedures.



7. Explain and demonstrate how to assemble pumps in accordance with precision maintenance processes and according to approved procedures, including each of the following:
  - A. Proper inspection of component shafting, including runout, diameters, shoulder squareness, and fillet radii.
  - B. Proper installation of duplexed angular contact ball bearings, tapered roller bearings, and tapered-bore spherical roller bearings.
  - C. Proper installation of shaft seals, including:
    - 1) Compression packing
    - 2) Component-type Mechanical seals
    - 3) Cartridge-type Mechanical seals
    - 4) Labyrinth Seals
    - 5) Carbon Seals
  - D. Setting impeller position and clearances.
8. Explain and demonstrate how to properly perform post-assembly checks and inspections on pumps in accordance with precision maintenance processes and according to approved procedures.
9. Explain and demonstrate how to properly install the following types of couplings, including adherence to precautions associated with setting the proper coupling gap:
  - A. Shim Pack Couplings
  - B. Gear Couplings
  - C. Elastomeric Couplings
10. Explain precautions associated with proper installation of pumps, including identification and resolution of problems associated with:
  - A. Bases and foundations
  - B. Pipe strain
  - C. Coupling Gaps
  - D. Soft Foot
  - E. Thermal Growth/Dynamic Movement



## Seminar Outline

### Day 1

- 1.0 Introduction
- 2.0 Precision Maintenance Fundamentals Review
  - 2.2 Maximizing Machinery Reliability Concepts
  - 2.3 Dimensions, Fits and Tolerances
  - 2.4 Precision Measurement
  - 2.5 Fastening, Torquing and Tensioning
  - 2.6 Precision Assembly
  - 2.7 Alignment Fundamentals
  - 2.8 Prealignment Considerations
  - 2.9 Precision Alignment Overview
  - 2.10 Belt Drive Precision Maintenance
  - 2.11 Bearing Fundamentals
  - 2.12 Types of Bearings
  - 2.13 Bearing Specification Concepts
- 3.0 Principles of Operation of Pumps
  - 3.1 Pumps
    - A. Types of Pumps
    - B. Principles of Operation
    - C. Component Parts and Functions
    - D. Pump Terminology
    - E. Pump Performance Curves
    - F. Typical Problems
    - G. Common Repair Tasks

### Day 2

- 4.0 Pre-Disassembly Inspections
  - 4.1 General Inspection Criteria
  - 4.2 Pump Inspection Procedures
  - 4.3 Pre-disassembly Inspection Activities
- 5.0 Disassembly Inspections
  - 5.1 General Inspection Criteria
  - 5.2 Pump Inspection Procedures
  - 5.3 Disassembly Inspection Activities
- 6.0 Dimensions, Fits, Tolerances and Precision Measurement
  - 6.1 Required Pump Fits, Tolerances and Measurements
  - 6.2 Precision Measurement Activities



## Days 3 & 4

- 7.0 Precision Assembly Procedures
  - 7.1 Pump Assembly
  - 7.2 Precision Assembly Activities
  
- 8.0 Post-Assembly Checks
  - 8.1 General Assembly Checks
  - 8.2 Pump Checks

## Day 5

- 9.0 Precision Installation Procedures
  - 9.1 Bases and Foundations
  - 9.2 Pipe Strain
  - 9.3 Coupling Gaps
  - 9.4 Soft Foot
  - 9.5 Thermal Growth/Dynamic Movement

### **NOTES:**

1. This seminar consists of over 50% hands-on activities. Activities are performed in groups of 2 for 12 person classes and groups of three for 18 person classes. All activities are accompanied by detailed activity guides and complete rebuild procedures for each of the machines included. Each activity is structured such that each group will rotate as needed from machine to machine, i.e., pump to fan to gearbox to turbine as needed to perform each of the critical tasks such as those listed in Seminar Objective #7.
  
2. Hands-on Activities will be performed on the specific types of pumps commonly repaired at the client's facility.

